CLAIMS

We claim:

1. A method of applying a sculptured layer of material on a semiconductor feature surface using ion deposition sputtering, wherein a surface onto which the sculptured layer is applied is protected to resist erosion and contamination by impacting ions of a depositing layer, said method comprising the steps of:

a) applying a first portion of a sculptured layer using traditional sputtering or ion deposition sputtering in combination with sufficiently low substrate bias that a surface onto which said sculptured layer is applied is not eroded away or contaminated in an amount which is harmful to said semiconductor feature performance or longevity; and

b) applying a subsequent portion of said sculptured layer using ion deposition sputtering with sufficiently high substrate bias to sculpture a shape from said the first portion, while depositing additional layer material.

2. The method of Claim 1, wherein said sculptured layer exhibits a substantially uniform thickness.

3. The method of Claim 1 or Claim 2, wherein said sculptured layer is a barrier layer or a wetting layer.

4.. The method of Claim 3, wherein the minimum thickness of said barrier layer or setting layer at any point on said semiconductor feature surface is about 5 Å.

5. The method of Claim 4, wherein said semiconductor feature size is less than about 5 μm with an aspect ratio of at least 1.

6. The method of Claim 5, wherein said semiconductor feature size is less than about 0.5 μm with an aspect ratio of at least 3.

7. The method of Claim 3, wherein said barrier layer comprises a material selected from the group consisting of Ta, TaN, TaSiN, Mo, MoN, MoSiN, TiN, TiSiN, W, WN, WSiN, and combinations thereof.

8. The method of Claim 3, wherein said wetting layer comprises a material selected from the group consisting of Ta, Mo, Ti, and combinations thereof.

9. The method of Claim 3, wherein said barrier layer is selected form the group consisting of Ti, TiN, and combinations thereof.

10. The method of Claim 1 or Claim 2, wherein said sculptured layer is a seed layer of a conductive material.

11. The method of Claim 10, wherein said conductive material is selected from the group consisting of Cu, Al, Ag, Ni, Au, W, and Pt.

12. The method of Claim 11, wherein said conductive material is copper.

13. The method of Claim 7, minimum thickness of said seed layer at any point on said semiconductor feature surface is about 5 Å.

14. The method of Claim 13, wherein said semiconductor feature size is less than about 5 μm with an aspect ratio of at least 1.

15. The method of Claim 14, wherein said semiconductor feature size is less than about 0.5 μm with an aspect ratio of at least 3.

16. The method of Claim 1 or Claim 2, wherein said substrate bias applied during the deposition of said first portion of said sculptured layer is less than about - 20 V.

17. The method of claim 1 or Claim 2, wherein no substrate bias is applied during the deposition of said first portion of said sculptured layer.

18. The method of Claim 1, or Claim 2, wherein said substrate bias applied during said subsequent portion of said sculptured layer is greater than about - 20 V.

19. The method of Claim 17, wherein said substrate bias applied during said subsequent portion of said sculptured layer is greater than about - 20 V.

20. The method of Claim 18, wherein said first portion of said sculptured layer is deposited using an IMP technique at a process chamber pressure of at least about 1 mT.

21. The method of Claim 19, wherein said first portion of said sculptured layer is deposited using an IMP technique at a process chamber pressure of at least about 1 mT.

22. The method of Claim 20, wherein said first portion of said sculptured layer is deposited using an IMP technique at a process chamber pressure of at least about 10 mT.

23. The method of Claim 21, wherein said first portion of said sculptured layer is deposited using an IMP technique at a process chamber pressure of at least about 10 mT.

24. The method of Claim 18, wherein said first portion of said sculptured layer is deposited using a standard sputtering technique at a process chamber pressure of 10 mT or less.

25. The method of Claim 18, wherein said second portion of said sculptured layer is deposited using an IMP technique at a process chamber pressure of at least about 1 mT.

26. The method of Claim 19, wherein said second portion of said sculptured layer is deposited using an IMP technique at a process chamber pressure of at least about 1 mT.

27. The method of Claim 20, wherein said second portion of said sculptured layer is deposited using an IMP technique at a process chamber pressure of at least about 10 mT.

28. The method of Claim 21, wherein said first portion of said sculptured layer is deposited using an IMP technique at a process chamber pressure of at least about 10 mT.

29. The method of Claim 12, wherein said substrate temperature during application of said copper seed layer is less than about 500 °C.

30. The method of Claim 29, wherein said substrate temperature is less than about 200 °C.